

- 22 -

WHAT IS CLAIMED IS:

1. A gas stream vortex mixing system for mixing gas, the gas stream vortex mixing system comprising:
a duct provided with an outer surface defining an interior passageway operable for communicating a gas;
at least one wing disposed within the interior passageway of the duct operable for generating at least one vortex; and
at least one nozzle disposed within the interior passageway of the duct, the nozzle operable to discharge a mixture into the interior passageway of the duct.
2. The gas stream vortex mixing system of claim 1 wherein the nozzle is disposed adjacent the wing and operable to discharge the mixture into at least one of the vortices generated by the wing.
3. The gas stream vortex mixing system of claim 2 wherein at least one wing disposed within the interior passageway of the duct is operable to generate lift.
4. The gas stream vortex mixing system of claim 3 wherein at least one wing is operable to shed at least one vortex at a point on the wing.
5. The gas stream vortex mixing system of claim 4 wherein at least one nozzle is positioned adjacent the point on at least one wing where the vortex is shed.
6. The gas stream vortex mixing system of claim 4

1-31 w/ + rev

- 23 -

98/10
wherein at least one wing is suspended within the interior passageway of the duct.

7. The gas stream vortex mixing system of claim 4 wherein the duct is provided with an inner surface further defining the interior passageway and wherein at least one wing is attached to the inner surface of the duct and extending therefrom into the interior passageway of the duct.

8. A gas stream vortex mixing system for mixing combustion exhaust gas, the gas stream vortex mixing system comprising:

a duct provided with an outer surface defining an interior passageway operable for communicating a combustion gas;

at least one wing disposed within the interior passageway of the duct operable for generating a vortex; and

at least one nozzle disposed adjacent the wing within the interior passageway of the duct, the nozzle operable to discharge a mixture into the vortex generated by the wing.

9. The gas stream vortex mixing system of claim 8 wherein at least one wing disposed within the interior passageway of the duct is operable to generate lift.

10. The gas stream vortex mixing system of claim 9 wherein at least one wing is a substantially symmetrical airfoil.

- 24 -

11. The gas stream vortex mixing system of claim 9 wherein at least one wing is a cambered wing.

12. The gas stream vortex mixing system of claim 9 wherein at least one wing is a substantially arcuate shaped airfoil.

13. The gas stream vortex mixing system of claim 12 wherein at least one substantially arcuate shape relates to a camber line of a cambered wing.

14. The gas stream vortex mixing system of claim 13 wherein at least one wing is constructed of a substantially rigid material.

15. The gas stream vortex mixing system of claim 14 wherein the rigid material is sheet metal.

16. The gas stream vortex mixing system of claim 9 wherein at least one wing is further defined as an airfoil provided with a camber line.

17. The gas stream vortex mixing system of claim 16 wherein the at least one wing is positioned within the interior passageway of the duct such that a chord line defining a straight line extending a distance relative to a cross section of the wing is substantially parallel to a line defining the direction of the flow of combustion gas within the interior passageway of the duct.

18. The gas stream vortex mixing system of claim 17 wherein the chord line of the wing is positioned at an

- 25 -

angle of attack of from 5 degrees through 15 degrees relative to the line defining the direction of the flow of combustion gas within the interior passageway of the duct.

19. The gas stream vortex mixing system of claim 17 wherein the chord line of the wing is positioned at an angle of attack of from 8 degrees through 12 degrees relative to the line defining the direction of the flow of combustion gas within the interior passageway of the duct.

20. The gas stream vortex mixing system of claim 17 wherein at least one wing is operable to shed at least one vortex at a point on the wing.

21. The gas stream vortex mixing system of claim 20 wherein at least one nozzle is positioned adjacent the point on at least one wing where the vortex is shed.

22. The gas stream vortex mixing system of claim 17 wherein at least one nozzle discharges the mixture in a direction with the flow of combustion gas.

23. The gas stream vortex mixing system of claim 22 wherein at least one nozzle is positioned adjacent the point on at least one wing where the vortex is shed.

24. The gas stream vortex mixing system of claim 17 wherein at least one nozzle discharges the mixture in a direction against the flow of combustion gas.

- 26 -

25. The gas stream vortex mixing system of claim 24 wherein at least one nozzle is positioned adjacent the point on at least one wing where the vortex is shed.

26. A gas stream vortex mixing system for mixing combustion exhaust gas, the gas stream vortex mixing system comprising:

a duct provided with an outer surface defining an interior passageway operable for communicating a combustion gas;
at least one wing operable to generate lift positioned within the interior passageway of the duct such that having a chord line defining a straight line extending a cross sectional distance of the wing is substantially parallel to a line defining the direction of the flow of combustion gas within the interior passageway of the duct, the wing operable for generating at least one vortex at a point on the wing; and
at least one nozzle disposed adjacent the wing within the interior passageway of the duct, the nozzle operable to discharge a mixture into the vortex generated by the wing.

27. The gas stream vortex mixing system of claim 26 wherein a plurality of wings are disposed within the interior passageway of the duct.

28. The gas stream vortex mixing system of claim 27 wherein duct is provided with an inner surface such that the plurality of wings are attached to the inner surface

- 27 -

of the duct and extend therefrom into the interior passageway of the duct.

29. The gas stream vortex mixing system of claim 28 wherein the plurality of wings are attached to the inner surface of the duct about a plane extending substantially perpendicular to the inner surface of the duct.

30. The gas stream vortex mixing system of claim 29 wherein the chord line of the plurality of wings is positioned at an angle of attack of from 5 degrees through 15 degrees relative to the line defining the direction of the flow of combustion gas within the interior passageway of the duct.

31. The gas stream vortex mixing system of claim 29 wherein the chord line of the wing is positioned at an angle of attack of from 8 degrees through 12 degrees relative to the line defining the direction of the flow of combustion gas within the interior passageway of the duct.

32. A method of mixing gas by creating a predictable and ordered vorticity, the method comprising: providing a gas stream vortex mixing system comprising:
a duct provided with an outer surface defining an interior passageway operable for communicating a combustion gas;
at least one wing disposed within the interior passageway of the duct operable for generating at least one vortex; and

- 28 -

at least one nozzle disposed within the interior passageway of the duct, the nozzle operable to discharge a mixture into the interior passageway of the duct;
providing a supply of combustion gas into the interior passageway of the duct such that the combustion gas passes about at least one of the wings of the gas stream vortex mixing system generating a vortex; and
discharging the mixture from at least one nozzle into the vortex such that the mixture is homogenized with the combustion gas within the vortex.

33. The method of claim 32 wherein the mixture is discharged from a plurality of nozzles into a plurality of vortices such that the mixture is homogenized with the combustion gas within the plurality of vortices.

34. The method of claim 33 wherein at least one wing provides a defined point upon which to shed at least one vortex so as to maximize the ordered flow of combustion gas within the interior passageway of the duct.

35. A method of mixing gas by creating a predictable and ordered vorticity, the method comprising:
providing a gas stream vortex mixing system comprising:
a duct provided with an outer surface defining an interior passageway operable for communicating a combustion gas;

- 29 -

at least one wing operable to generate lift positioned within the interior passageway of the duct such that a chord line defining a straight line extending a cross sectional distance of the wing is substantially parallel to a line defining the direction of the flow of combustion gas within the interior passageway of the duct, the wing operable for generating at least one vortex at a point on the wing; and at least one nozzle disposed adjacent to the wing within the interior passageway of the duct, the nozzle operable to discharge a mixture into the vortex generated by the wing; providing a supply of combustion gas into the interior passageway of the duct such that the combustion gas passes about at least one of the wings of the gas stream vortex mixing system generating a vortex; and discharging the mixture from at least one nozzle into the vortex such that the mixture is homogenized with the combustion gas within the vortex.

36. The method of claim 35 wherein the mixture is discharged from a plurality of nozzles into a plurality of vortices such that the mixture is homogenized with the combustion gas within the plurality of vortices.

37. The method of claim 35 wherein the chord line of the wing is positioned at an angle of attack of from 5 degrees through 15 degrees relative to the line defining

- 30 -

the direction of the flow of combustion gas within the interior passageway of the duct.

38. The method of claim 35 wherein the chord line of the wing is positioned at an angle of attack of from 5 degrees through 15 degrees relative to the line defining the direction of the flow of combustion gas within the interior passageway of the duct.

39. The method of claim 35 wherein at least one wing provides a defined point upon which to shed at least one vortex so as to maximize the ordered flow of combustion gas within the interior passageway of the duct.

40. The method of claim 39 wherein at least one nozzle is positioned adjacent the point on at least one wing where the vortex is shed.

41. The method of claim 40 wherein at least one nozzle discharges the mixture in a direction with the flow of combustion gas.

42. The method of claim 40 wherein at least one nozzle discharges the mixture in a direction against the flow of combustion gas.